I. CLAIM AMENDMENTS

Claims 1-3, 6-10 and 12-18 have been amended to provide consistency in claim language. Specifically, original claim 1 inadvertently referred to both an "optical confinement *layer*" and an "optical confinement *region*". The claims have been amended to refer more consistently to an "optical confinement *region*". Such amendment is intended simply to provide consistency in claim language, and is not intended to affect the scope of applicant's claims in any manner.

Claims 30 and 31 have been added to define further the features of the present invention. Support for such claims may be found, for example, in the last paragraph on page 14 and the first two paragraphs on page 15 of the specification.

II. ALLOWABLE SUBJECT MATTER

Applicant acknowledges with appreciation the indicated allowability of claims 3, 5-7 and 18, subject to being amended to independent form. Applicant further acknowledges the allowance of claims19-22.[1]

III. REJECTIONS OF CLAIMS 1, 2, 4 AND 8-17 UNDER 35 USC §103(a)

Claims 1, 2, 4 and 8-12 are rejected under 35 USC §103(a) based on *Hayakawa*. Claims 13-15 are also rejected under 35 USC §103(a) based on *Hayakawa*. Moreover, claims 16-17 are rejected under 35 USC §103(a) based on *Hayakawa*. Each of these rejections is respectfully traversed for at least the following reasons.

i. Hayakawa discloses that the refractive index of the optical guide be greater than or equal to the cladding region. This is both intuitive and preferable to contain the laser mode. It is therefore not obvious to insert a low refractive index region in the optical guide. The same holds true for the high aluminum region in the optical guide.

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[1]Clarification is respectfully requested regarding the status of claims 24-29. The Examiner indicates that these claims are allowable due to their dependency on claim 22. However, claims 24-29 are actually dependent from claim 1 either directly or indirectly.

Regarding claim 1, the Examiner contends that *Hayakawa* teaches each of the recited features with the exception of the at least one optical confinement region having a lower refractive index then the at least one of the cladding regions. Thus, the Examiner admits that *Hayakawa* does not describe the feature of an optical confinement region with a lower refractive index. However, the Examiner contends that one having ordinary skill in the art would have found the advantage and desirability of an optical confinement region having a lower refractive index to be obvious for improving optical and electrical effects of the system (See, e.g., OA, page 3).

Applicant respectfully submits that the Examiner is improperly using hindsight in the rejection of the claims. Applicant submits that none of the cited references suggest that an optical guiding region disposed as claimed and having a refractive index lower than that of the cladding regions, as claimed, would provide the effect of suppressing a leakage of carriers.

Nevertheless, Applicant further submits that it is not obvious from *Hayakawa* to provide a optical confinement region having a lower refractive index than that of the cladding layer. Instead, Applicant submits that *Hayakawa* fairly suggests that the bridging layers (80, 82, 84, 86) have a refractive index greater than or equal to the refractive index of the cladding layers (54, 58), which is contrary to the invention as claimed, for reasons as follows.

Hayakawa firstly discloses at Col. 6, lines 63-68, that the cladding layers (54, 58) are comprised of $(Al_{0.6}Ga_{0.4})_{0.5}In_{0.5}P$. *Hayakawa* then discloses at Col. 7, lines 11-21, that the optical guide layers (72, 74) which include the bridging layers (80, 82, 84, 86) are comprised of $(Al_xGa_{1-x})_{0.5}In_{0.5}P$. It is noted from Fig. 1 that at the interface of the bridging layers (80 and 86) and the cladding layers (54, 58), the Al ratios of the bridging layer and the cladding layers are the same.

In view of the above, it is apparent than an Al content of the bridging layers is the same or lower than that of the cladding layers, and accordingly a Ga content of the bridging layers is the same or higher than that if the cladding layers.

Now referring to page 15, second paragraph, of the specification, it is disclosed than an AlInP (i.e. $Ga_{0.0}$) optical confinement region has a lower refractive index than a

$(Al_{0.4}Ga_{0.6})_{0.52}In_{0.48}P$ optical guiding layer. It is further disclosed that a $(Al_{0.7}Ga_{0.3})_{0.52}In_{0.48}P$ cladding region has a lower refractive index than a $(Al_{0.5}Ga_{0.5})_{0.52}In_{0.48}P$ optical guiding region.

It therefore appears that a higher ratio of Al and consequently a lower ratio of Ga lowers the refractive index of a region.

Hayakawa discloses a structure where the bridging layers have a lower ratio of Al and a higher ration of Ga than the cladding layers. Applicant submits that *Hayakawa* teaches away from the claimed invention and instead provides a bridging layer which has a higher refractive index than the cladding layer. The claimed invention explicitly claims an optical confinement region with a refractive index lower than that of the cladding layer and therefore clearly contradicts the teachings of *Hayakawa*.

One having ordinary skill in the art would not have arrived at the claimed invention having read the disclosure of *Hayakawa* since *Hayakawa* clearly teaches away from the claimed invention. One having ordinary skill in the art, in following the teachings of *Hayakawa* would have always obtained a structure where a composition of the bridging layers and the cladding layers is such that the bridging layers have a higher refractive index than the cladding layers.

Reconsideration of claim 1, and all claims dependent therefrom, is respectfully requested.

ii. Hayakawa teaches only a graded optical guide, not a graded cladding layer. It is not obvious from the teachings of Hayakawa to grade the cladding layer. Grading the cladding region is not generally preferable due to the formation of an electrical barrier to charge carriers.

Regarding the Examiner's rejection of claim 4, the Examiner contends that Fig. 1, Col. 3, lines 7-64 and Col. 7, lines 10-33, of *Hayakawa* discloses a cladding layer having a graded bandgap. Applicant respectfully disagrees. Fig. 1 clearly shows that an Al ratio of the cladding regions is fixed. Col. 3, lines 7-64, discloses only that the bridging layers and optical guide layers are graded, the cladding layers appear to be non-graded. Col. 7, lines 10-33 similarly only mentions that a bridging layer and an

optical guide layer are graded, but not a cladding layer. Reconsidering of claim 4 is respectfully requested.

Similarly, *Hayakawa* does not disclose the feature of claim 12 where an aluminum mole fraction Y decreases away from the at least one optical confinement layer.

> *iii.* *Choosing an aluminum fraction to be higher than the cladding layer in at least one of the optical guide layers has potential technical advantages in terms of both improved electrical and optical confinement. It is therefore not simply a design choice. Hayakawa teaches a continuous first derivative of aluminum fraction but does not teach that a layer with higher aluminum than the cladding region could be used as an optical guide.*

Regarding the Examiner's rejection of claims 13-15, the Examiner contends that choosing an Al mole fraction higher than that of a cladding region is merely a design choice. However, the Examiner is referred to Col. 6, lines 3-14, and Col. 7, lines 23-29 of *Hayakawa* where it is explicitly stated that a characterizing feature of *Hayakawa* is that of providing a bridging layer between the optical guide layer and the cladding layer so as to provide a composition profile having a continuous first derivative with respect to the thickness of the structure.

From the above, it is clear that one would not increase the aluminum mole fraction in the bridging layer higher than that of the cladding layer since that would be going against the characterizing purpose of *Hayakawa*. Applicant submits that a combination, as suggested by the Examiner, would render the invention of *Hayakawa* ineffective for its intended use, and as such, cannot be grounds for a rejection under §103(a).

Reconsideration of the rejected claims is respectfully requested.

IV. CONCLUSION

Accordingly, all claims 1-29 are believed to be allowable and the application is believed to be in condition for allowance. A prompt action to such end is earnestly solicited.

Should the Examiner feel that a telephone interview would be helpful to facilitate favorable prosecution of the above-identified application, the Examiner is invited to contact the undersigned at the telephone number provided below.

Should any fees be due as a result of the filing of this response, the Commissioner is hereby authorized to charge the Deposit Account No. 18-0988.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Box Non-Fee Amendment, Assistant Commissioner for Patents, Washington, D.C. 20231.

April 30, 2002
DATE

Appendix

IN THE CLAIMS:

Claims 1-3, 6-10 and 12-18 have been amended as follows:

1. (Amended) A laser device comprising: an n-doped cladding region and a p-doped cladding region; an optical guiding region disposed between the n-doped cladding region and the p-doped cladding region; and an active region disposed within the optical guiding region;

wherein the laser device further comprises at least one optical confinement [layer] region disposed between the active region and at least one of the cladding regions, the at least one optical confinement region having a lower refractive index than the at least one of the cladding regions, and

wherein the laser device emits light in the visible region.

2. (Amended) A laser device as claimed in claim 1, wherein the at least one optical confinement [layer] region is disposed at the interface between the optical guiding region and one of the cladding regions.

3. (Amended) A laser device as claimed in claim 2, wherein the Γ-conduction band of the part of the one cladding region immediately adjacent the at least one optical confinement [layer] region is substantially degenerate with the X-conduction band of the at least one optical confinement [layer] region.

6. (Amended) A laser device as claimed in claim 2, wherein the DX level in the part of the at least one cladding region adjacent the at least one optical confinement [layer] region is substantially degenerate with the X-conduction band in the optical confinement [layer] region.

7. (Amended) A laser device as claimed in claim 1, wherein the energy of the DX level in the one cladding region increases away from the at least one optical confinement [layer] region.

8. (Amended) A laser device as claimed in claim 1, wherein the at least one optical confinement [layer] region is disposed on the p-side of the laser device and is p-doped.

9. (Amended) A laser device as claimed in claim 1, further comprising a second optical confinement [layer] region disposed between the active region and the other of the cladding regions.

10. (Amended) A laser device as claimed in claim 9, wherein the second optical confinement [layer] region is disposed at the interface between the optical guiding region and the other of the cladding regions.

12. (Amended) A laser device as claimed in claim 11, where y decreases away from the at least one optical confinement [layer] region.

13. (Amended) A laser device as claimed in claim 11, wherein the at least one optical confinement [layer] region is an AlGaInP layer having a greater aluminum mole fraction than the respective cladding region.

14. (Amended) A laser device as claimed in claim 11, wherein the at least one optical confinement [layer] region is an AlInP layer.

15. (Amended) A laser device as claimed in claim 14, wherein the at least one optical confinement [layer] region consists of oxidised AlInP.

16. (Amended) A laser device as claimed in claim 11, wherein y is approximately 0.4 at the interface between the one cladding region and the at least one optical confinement [layer] <u>region</u>.

17. (Amended) A laser device as claimed in claim 11, wherein y is approximately 0.9 at the interface between the one cladding region and the optical confinement [layer] <u>region</u>.

18. (Amended) A laser device as claimed in claim 1, wherein the thicknesses of the optical guiding region and the or each optical confinement [layer] <u>region</u> are selected such that the laser device emits, in use, light having a substantially circular far-field profile.

Claims 30 and 31 have been added.